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THE first description of the slowing of the pulse during the puerperium is frequently ascribed to Blot in 1864, yet it requires but the briefest review of the literature to indicate that the credit is not rightfully his. It is difficult to isolate the one who first described it, yet we have strong suggestions that it was known to the ancients. That the phenomenon was known to the ancient Chinese may be evinced by the diction in Pfizmaier's "Die Pulslehre Tschang Ki:" "Ist die Geburt soeben erfolgt, so ist Kleinheit und Langsamkeit: bei Vollheit Straffheit, Festigkeit, Grösse ist das unglück nicht zu vermeiden." "Der Kleine und langsame puls wird in der Erklärung als von guter vorbeutung bezeichnet." In more recent time we find many who also mention this phenomenon, unaware doubtless that it had been described by others. Thus we find reference made of it by Levret (1766), Cirillo (1802), and Capuron (1811). In 1857 W. E. Montgomery wrote of it in a Dublin journal under the heading of "Retardation of the pulse after labor," and MacClintock's much quoted observations appeared four years later. Moreover immediately preceding the paper of Blot appeared the publications of Levy (1862) and Pastorello (1863).

Yet credit is due Blot for first presenting in a complete and careful manner his many observations concerning this phenomenon. His paper, which was based upon the study of 246 parturient women, created a profound sensation when read before the Paris Academy in 1863. It was published the succeeding year. Blot presented the following conclusions:

1. That there generally ensues in normal puerperal women a more or less clearly marked slowing of the pulse.

2. It is not limited to women who normally have slow pulses at other times.

3. The range of the pulses varies considerably, yet commonly oscillates between 44 and 60. In three cases the pulse fell to 35

per minute. The phenomenon is not influenced appreciably by the alimentary tract.

4. The condition is more common in multipara than primipara, doubtless because of the greater tendency to complications in the latter.

5. The duration of the fall varies from a few hours to ten or twelve days, and is usually more prolonged in the cases which present the slowest pulses, provided always that there are no complications.

6. It begins usually in the 24 hours following delivery, becomes accentuated, remains stationary, and gradually disappears. It may persist even while there is "milk fever," a term often erroneously applied.

7. The duration of labor does not profoundly influence the phenomenon, which disappears, however, upon the advent of pathological conditions. The pulse is retarded not only after labor at term, but also after abortions and premature labors, whether spontaneous or induced. The ordinary afterpain does not influence it, yet hæmorrhage may, unless the amount is very slight.

8. Changes in the posture of the patient cause marked changes in the rate.

9. The slow pulse is a most favorable symptom, and its frequent occurrence in a hospital reflects the excellence of the sanitary conditions. The reverse condition, a rapid pulse, often proclaims the advent of morbid conditions which so frequently appear in epidemic form.

10. Whatever is the cause, it cannot be ascribed to nervous exhaustion, because the sphygmographic tracings indicate an increase of arterial tension.

Shortly following Blot's publication, the literature became flooded with the observations of many investigators who recorded their findings with the sphygmograph which was then becoming a favorite instrument with students of the circulation. Naturally there accumulated a great number of observations, which together with their interpre-

tations, forms a considerable literature. In a general manner the results of the later workers corroborated the findings of Blot. There is not, however, complete agreement as to details. Falaschi showed that a slow pulse is not found in abortions prior to the fourth month. Others found that hæmorrhage and the shock from operative procedures aimed at delivery held the fall in abeyance. There was not an agreement as to what constituted the average rate of the puerperal pulse. Thus while Blot stated that the average of the pulse ranged between 44 and 60, Vejas found but 60 per cent of 50 cases which presented pulses under 72. Falaschi observed slow pulses in but one quarter of his cases. Olshausen found that 63 per cent of 348 cases had pulses of 60 or under, while Hémeý's careful study showed a similar condition in but 16.2 per cent. Winckel observed puerperal pulses between 60 and 51 in 38 per cent of cases, while in 22 per cent they were between 50 and 39. Löhlein, on the contrary, found pulses below 50 in but 6.5 per cent of cases, which findings agree with Knapp's observations. All agree that the slow pulse is more common in multipara than primipara. Blot showed the ratio as two to one, Louge as four to one, Vejas found a fall in two-thirds of the multipara and half of the primipara.

The average rate of slow pulse varied in different series. Olshausen took it as from 40 to 50; Falaschi as 44 to 50; Blot as 44 to 60; Hémeý as 48 to 52; Louge as 50 to 60; Torgler as 60 to 80; and Vejas as 72 to 78.

There is also considerable variation as to the day on which the maximum of fall was observed, and various periods between one and twelve days are recorded. Thus we find the maximum of fall:

A few hours after birth, Vejas, Carl.

After twenty-four hours, Fritsch, Knapp.

Fourth to sixtieth hour, Falaschi.

End of second day, Blot.

Second to fifth day, Fehling.

Fifth to seventh day, Olshausen.

Fifth to eighth day, Löhlein.

Morning of seventh day, Louge.

Evening of seventh day, Baumfelder.

Seventh to ninth day, Deubel.

Ninth day, Meyburg.

The slowest pulses recorded are by MacClintock, 30 beats to the minute, following the delivery of triplets; Olshausen, 34; Blot, 35; Meyburg, 36; Falaschi, 38.

Practically all the authors quoted state that the slow pulse after labor is a physiological phenomenon and constitutes a true fall in the pulse rate. It is apparent to any one that it is necessary to know the pulse rate of the individual both before and during pregnancy, before we can show that a fall in the rate has occurred in the puerperium. Critical study of the work quoted above shows that no series complies with these postulates, and that only Hémeý and Vejas made their observations on the same women before and after delivery. The others took an arbitrary rate for the normal patient during pregnancy, and it is of interest to note that few authors took the same rate for the normal. Moreover, others considered as a pronounced slowing, a pulse five beats below the figure arbitrarily taken as the normal pulse of pregnancy. It is little wonder then that Heil reviewed the subject in 1898 in an article entitled "Giebt es eine physiologische Pulsverlangsamung in Wochenbett." His article was based upon the study of 100 cases in the gynecological wards and 100 cases in the obstetrical wards of Kehrer in Heidelberg. His conclusions may be briefly summarized.

The pulse in 100 women who were not pregnant but who had been in bed for several days, frequently fell below 75. In 49 per cent of cases it reached 65 and lower. These women were in the clinic for treatment of slight grades of endometritis, stenosis of os cervix, etc.

In pregnant women, after one-half hour's rest in bed, the morning pulse fell below 75 in 60.8 per cent; below 65 in 24.5 per cent; and below 60 with a minimum of 48 in 11.5 per cent of cases.

Pulses of 65 and lower were observed more frequently in pregnancy than in the first ten days of the puerperium.

The average of the pulses during pregnancy was higher than that of the puerperium in 45 per cent of cases.

The average of the pulses during the puer-

perium is ten or more beats slower than that of the pregnancy in but 12 per cent of cases, 2 per cent being primipara and 10 per cent multipara; in 22 per cent of cases it was between 5 and 10 beats slower.

A curve of the daily average puerperal pulse shows a range from 71 to 75 during the first eight days, with 78 on the ninth day and 81 on the tenth day.

Even admitting that there are errors in conclusions from a small number of cases, Heil does not believe that there is a physiological slowing of the pulse which is limited to the puerperium in the sense that has hitherto been held.

Aichel in Erlangen in 1901 tabulated the average pulse of 79 absolutely normal women. His study included the last ten days of pregnancy and the first ten days of the puerperium. The average daily pulse in this series oscillated between 70 and 78 in both pregnancy and the puerperium. In only six cases (7.5 per cent) was there a fall in the average pulse rate during the puerperium. In 61 cases (77 per cent) was the pulse the same, and in 12 cases (14 per cent) was it the higher in the puerperium.

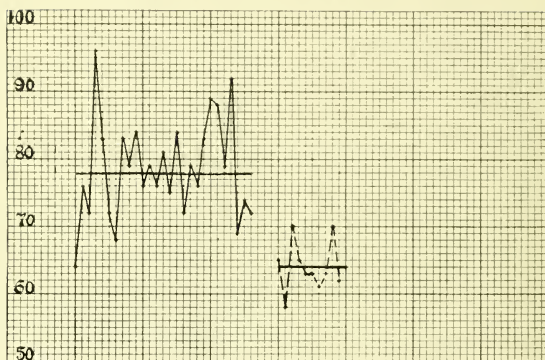
Varnier in 1900 reported two series of cases. All the pulses were counted at nine o'clock in the morning while the patient was in bed. We must omit from our consideration the first series because it does not deal with the same women in pregnancy and the puerperium. The second series meets all requirements save the small number of cases observed (36 cases). His conclusions are of the greatest interest in that they show that the pulse fell during the puerperium in 72.2 per cent of the cases of the series, and was higher in but 11.1 per cent.

Various theories have been propounded by those who have described a slowing of the pulse rate during the puerperium. We believe that the list exhausts nearly all of the possibilities. Thus, Kehrer ascribed the phenomenon to the lowering of the blood pressure after delivery; Schroeder, to the sudden diminution of the maternal vascular area after the uteroplacental circulation is thrown out of function; Löhlein, to the stimulation of the vagus or other nervous influences;

Olshausen, to the absorption of various products set free in the blood during the involution of the uterus; and Kehrer, to the horizontal position and rest in bed.

My attention was directed to this subject some years ago when, as a medical student, I was unable to observe a slow pulse in any of the cases to which I was assigned on obstetrical duty. I still recall my fears lest these women had been infected by me. We began this investigation in 1901 in the clinic of Prof. Williams in Johns Hopkins Hospital, for the purpose of controlling the reports of Heil and Varnier, recognizing that unusual opportunities were afforded in a clinic which was maintained primarily for teaching, and thus held many patients under observation for long periods of time for use in the teaching of palpation and pelvimetry. In all, more than 250 cases were followed, but this number became decimated by incomplete records, as well as by the advent of complications in many cases. My thanks are due Prof. Williams for the use of his cases.

We have attempted to consider only normal cases and have therefore excluded all which presented albuminuria other than in the faintest traces and not accompanied by casts, hæmorrhage, breast complications, sloughing of sutures, a temperature continuous above 100° F. for more than eight successive hours, etc. All the women nursed their children and all children were full term. There are many sources of error in a work of this character, many of which cannot be controlled. One possibly is in the use of chloroform in very small amounts during the second stage of labor, as well as for complete anaesthesia in the cases of perineal repair. We have sought to limit this error by the exclusions of all cases with lacerations more serious than simple first and second degree tears requiring less than four or five sutures. That error from this source is not considerable is proven by the data obtained in a series of 19 primipara which were delivered by low forceps or breech extractions not indicated by maternal exhaustion. Nine of these cases presented a slower pulse average in the puerperium than in pregnancy by from 3 to 10 beats, while in only two cases was the condition reversed.

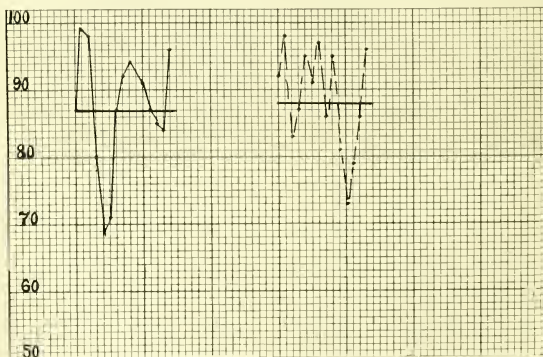


Primipara. Fall of 14 beats.

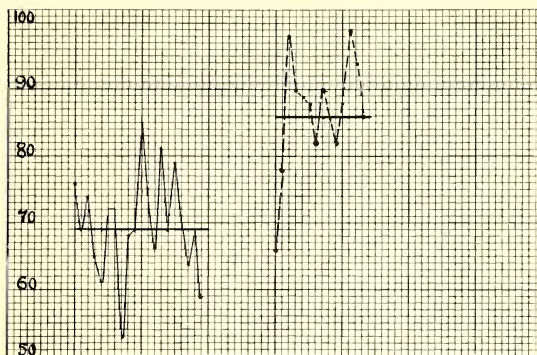
This is practically the same as the percentages obtained in the series of spontaneous births in primipara, and for that reason have been included in our series. All other cases had spontaneous births. Attempt was made to take all pulses at 9 A. M., but after fifty cases the hour was changed to 7 P. M., at which time the majority of counts were made. The patients were kept as quiet as possible preliminary to taking the pulse, and 70 per cent of those not already in bed were sent there for at least fifteen minutes before the count. The smaller percentages were kept seated in chairs.

Our series comprises 185 cases, 103 being primiparae and 82 being multiparae. These women were observed for periods varying between 17 and 70 days, as shown by the following table:

No. of Days	PERIOD OF OBSERVATION		Total Cases
	Primipara No. of Cases	Multipara No. of Cases	
17-20	25	13	38
20-20	30	32	62
30-39	24	22	46
40-49	15	11	26
50-59	4	4	8
60-70	5	0	5



Primipara. Rise of 1 beat.

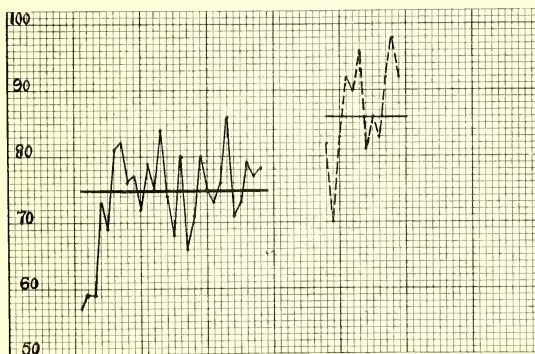


Primipara. Rise of 17 beats.

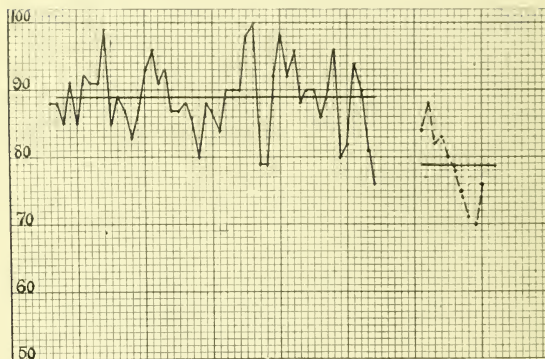
All cases were considered as units and the pulse records during pregnancy and the puerperium were charted on individual sheets in order to give a clear picture of the record of each patient. The average of the pulses during pregnancy was then taken and contrasted with that of the puerperium on each individual record. No case was admitted to our series in whom the pulse count had been omitted on two successive days of the first eight days of the puerperium. Study of table II shows

that the pulse averages during pregnancy were between one and three beats of that of the puerperium in 24 cases. We believe that these should be classified as "pulse unchanged" in order to further limit the errors attending the investigation of a phenomenon as delicate and variable as the pulse rate.

It will be recalled that Heil showed that "a marked slowing" of the pulse occurred in but 12 per cent of his cases. Heil's article primarily controverted the work of older



Primipara. Average rise 11 beats.

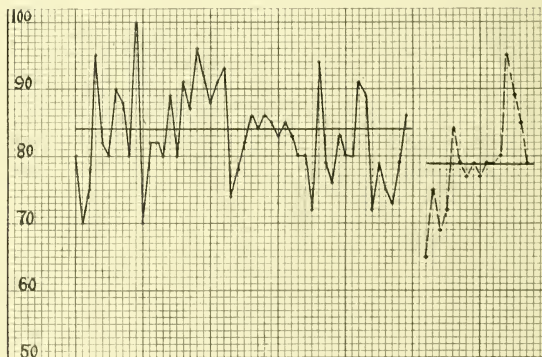


Primipara. 49 days' pregnancy, average pulse 80; 10 days' puerperium, 70.

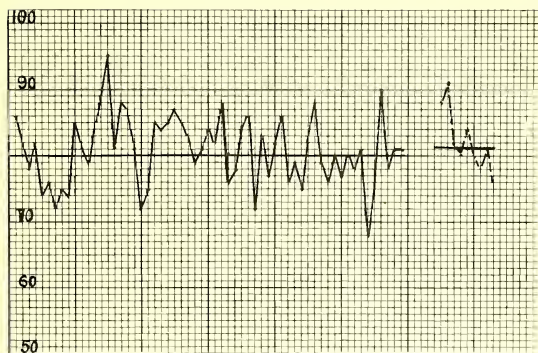
observers, who claimed that "a marked retardation" was to be expected during the puerperium of normal cases, and quite correctly Heil claimed that no case should be considered as an example of "a marked retardation" unless the average pulse rate was at least ten beats slower in the puerperium than in pregnancy. Our table shows that such a fall occurred in 20.5 per cent of our entire series, being observed in 12.7 per cent of the primipara, and 31.7 per cent of the multipara.

TABLE II

During the Puerperium	Total Series	Primipara	Multipara
Pulse rose	26 cases (14.1%)	18 cases (17.5%)	8 cases (9.8%)
Pulse unchanged	47 cases (25.4%)	33 cases (32.0%)	14 cases (17.0%)
Pulse fell	112 cases (60.5%)	52 cases (50.5%)	60 cases (72.2%)
<i>Pulse rose</i>			
1-3 beats	9 cases	5 cases	4 cases
3-5 beats	7 cases	4 cases	3 cases
6-10 beats	5 cases	4 cases	1 case
11-15 beats	2 cases	2 cases	
16-20 beats	2 cases	2 cases	
21+ beats	1 case	1 case	



Primipara. 51 days' pregnancy, average pulse 84; 16 days' puerperium, 70.



Primipara. 59 days' pregnancy, average pulse 80; 9 days' puerperium, 81.

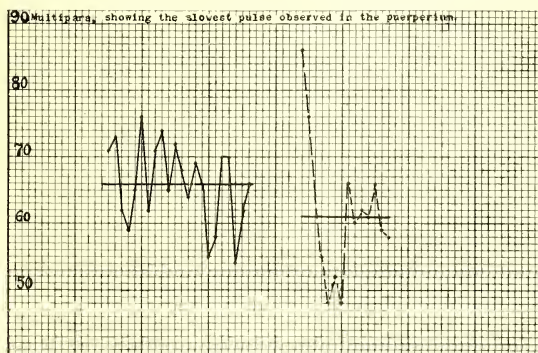
Pulse fell

1-3 beats	15 cases	9 cases	6 cases
4-5 beats	13 cases	7 cases	6 cases
6-10 beats	45 cases	23 cases	22 cases
11-15 beats	22 cases	7 cases	15 cases
16-20 beats	12 cases	6 cases	6 cases
21-24 beats	5 cases	0 cases	5 cases

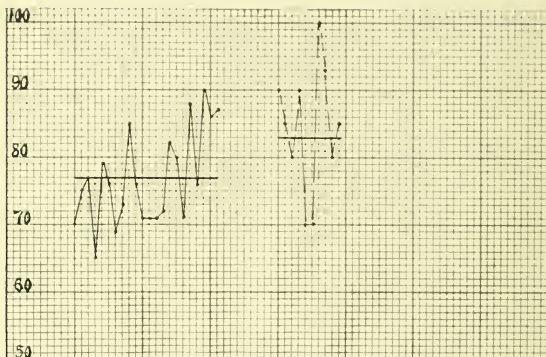
CORRECTED TABLE (SUMMARY)

	Total Series	Primipara	Multipara
Pulse rose more than 3 beats.....	(9.2%)	(13.6%)	(3.6%)
Pulse unchanged.....	(38.3%)	(44.6%)	(39.5%)
Pulse fell more than 3 beats.....	(52.7%)	(41.7%)	(65.9%)

The slowest pulse observed in any individual during this investigation was 46 to the minute, noted once in a white primipara whose pulse averaged 53 for the three days she was in the hospital prior to labor (counts of 46, 59, 54). She was delivered by a breech extraction under chloroform anaesthesia, and nursed her child. Her pulse averaged 86 for 14 days of the puerperium. The slowest pulse noted in the puerperium was 48, observed twice in a white woman who had borne



Multipara. Second child. Average of pulse 5 beats slower during puerperium. Average during the last seven days of pregnancy is practically the same as that of both the first and second seven days of puerperium.

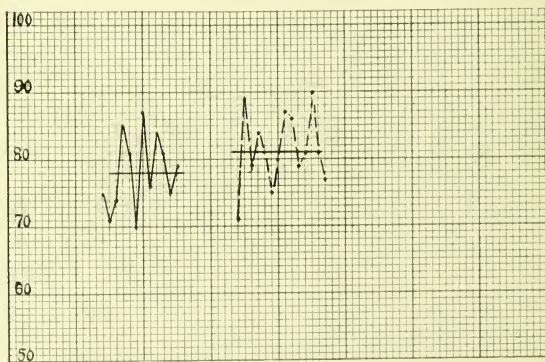


Multipara. Second child. Rise of 6 beats, the highest observed among the multipara.

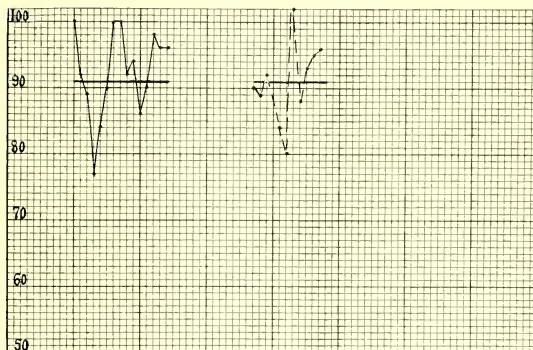
one child. The average pulse of this case was 66 for 23 days of pregnancy, and 61 for 14 days of the puerperium. (See figure.) Her slowest pulse noted by us in pregnancy was 54, five days prior to labor. The pulse average for the last seven days of pregnancy in this case was 62.5, which closely coincides with that of the puerperium which averaged 61 for both the first and second seven days. It was our habit to confirm the count of any pulse below 55 by the stethoscope, and we

found that the heart action was apt to be irregular in the slowest pulses.

The average of the pulses of the 103 primipara was 87 for pregnancy and 71 for the puerperium. The average of the pulses of the 82 multipara was 84 during pregnancy and 76 during the puerperium. This greater variation in the pulse of the primipara constitutes, we believe, one other expression of the more profound reaction of the first pregnancy upon the maternal organism. It is



Multipara. Third child. Average of pulse beats 3 higher during puerperium. Lacerations requiring four sutures healing puerperium.

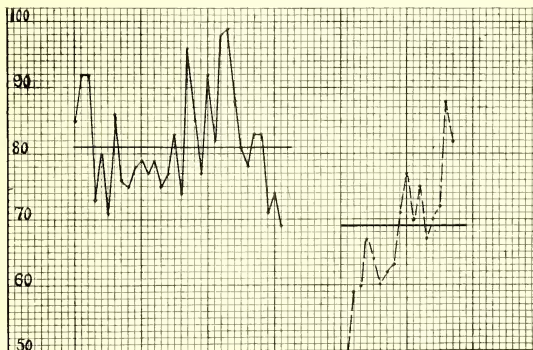


Multipara. Sixth child. Average of pulse unchanged during last 15 days of pregnancy and first 10 days of puerperium.

also a matter of interest that the pulse average in the puerperium became more elevated after the patient was no longer closely confined to bed (8 days) in but a small proportion of cases.

Inasmuch as we have not met with the characteristic curve of the pulse fall as described by Blot, we have not attempted to calculate the day on which the slowest pulses were observed.

Table III is arranged to show the frequency at which various pulse levels were observed in pregnancy and the puerperium. One may calculate from this table that an average pulse rate of 80 or more was observed in 68.1 per cent of all pregnancies combined, and but in 35.1 per cent of the puerperium. Considering the cases as either primipara or multipara, we find that 64 per cent of the primipara had an average of the pulses above 80



Multipara. Eight child. Pulse fall 12 beats. Pulse average while in bed first eight days of puerperium, 60. Thereafter, 74.

during pregnancy, while but 37.8 per cent had similar averages during the puerperium; also, that the corresponding percentages for the multipara were 73.1 in pregnancy, and 35.5 in the puerperium.

TABLE III

Showing the comparative frequency of the same pulse rate in pregnancy and the puerperium.

Total Series	185 Cases		103 Primipara		82 Multipara	
Pulse	Preg-nancy	Puer-perium	Preg-nancy	Puer-perium	Preg-nancy	Puer-perium
51-55	1 case	0 case	1 case	0 case	0 case	0 case
56-60	1 case	1 case	1 case	1 case	0 case	0 case
61-65	1 case	11 cases	0 case	2 cases	1 case	9 cases
66-70	4 cases	18 cases	3 cases	8 cases	1 case	10 cases
71-75	17 cases	35 cases	12 cases	17 cases	5 cases	18 cases
76-80	35 cases	55 cases	20 cases	35 cases	15 cases	20 cases
81-85	62 cases	38 cases	34 cases	21 cases	28 cases	17 cases
86-90	41 cases	14 cases	20 cases	9 cases	21 cases	5 cases
91	23 cases	13 cases	12 cases	10 cases	11 cases	5 cases

Table iv presents the cases of the series grouped in three different classes according to the rate of the pulse average during pregnancy, i. e., pulse average below 80, between 80 and 90, and above 90. It well shows that a woman who has a high pulse average during pregnancy is more apt to have the pulse rate fall in the average during the puerperium than one presenting a slower pulse average during pregnancy.

TABLE IV

Cases with pulse average below 80 during pregnancy.

Primipara, 37 cases	Multipara, 22 cases
30% rose during puerperium	22.5% rose during puerperium
37.8% unchanged	18.4% unchanged
32% fell	59.1% fell

Cases with pulse average between 80 and 90 during pregnancy.

Primipara, 54 cases	Multipara, 49 cases
11.1% rose during puerperium	6.1% rose during puerperium
29.6% unchanged	16.3% unchanged
59.3% fell	77.6% fell during puerperium

Cases with pulse average above 90 during pregnancy.

Primipara, 12 cases	Multipara, 11 cases
8.33% rose during puerperium	0% rose during puerperium
25% unchanged	18.2% unchanged
66.6% fell	81.8% fell

CONCLUSIONS

It is an extremely difficult matter to present other than general conclusions in a work which presents so large a limit of error as is necessitated by the taking of a pulse but once daily. Yet we believe that the following con-

clusions may be safely drawn. In our series of 103 primipara and 82 multipara, studied during pregnancy and the puerperium:

1. The average of the pulse in multipara was twice as apt to be slower in the puerperium than to remain at its previous level.

2. The average of the pulse of primipara was quite as likely to remain unchanged.

3. The average of the pulse was three or more beats slower during the puerperium in six of every ten of the women of the series.

4. A fall of ten or more beats was observed in but 20.5 per cent of our total series, yet was found in 31.7 per cent of the multipara and in but 12.7 per cent of the primipara.

5. The more rapid the pulse during pregnancy, the more apt it was to fall; the slower the pulse, the more apt it was to rise.

6. The average pulse rate during the puerperium is not accelerated after the patient leaves her bed on the eighth day in a large percentage.

7. The text-books err in stating that the fall in the pulse rate described by Blot is a usual phenomenon.

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